KARUNAMIRTHA SAGARAM.

RAO SAHIB M. ABRAHAM PANDITHER

EXTRACT
FROM
THE FIRST BOOK
ON
SRUTIS
PART I, II & III

An essay on Srutis read before the All-India Music
Conference held at Baroda under the kind patronage of
His Highness the Gaekwar of Baroda (22nd March, 1916)

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INTRODUCTION.

MAY the Blessings of the Lord Almighty whose sacred feet we worship and Who is the source of all learning and art vouchsafe His grace to us all.

I earnestly pray to God that His illustrious Majesty King Emperor George V, who rules India with justice and sympathy, and His gracious consort Queen Mary may be blessed with a long and prosperous life and that the benign British Government which is ever anxious to do all in its power for the good of the people, may live and grow for ever.

May His gracious Highness the Gaekwar who stands prominent among the ruling chiefs of India as the patron of all arts, learning, manufacture and culture and his illustrious consort Her Highness the Maharani be blessed with a long life.

As I was asked to say something on the Srutis of Indian music in the presence of his august assembly consisting, as it is of the Maharaja, his nobles and ministers, the illustrious Dewan V. P. Madava Row and of gentlemen of musical fame from different parts of India, I make bold to say a few words on the subject in obedience to that request. I earnestly request this learned assembly to be partial to my shortcomings but to give a serious consideration to any point which they may think worthy of notice.

We hold with pardonable pride that all the fine arts—Music, Painting, Poetry, Sculpture and Architecture—flourished scientifically in India from very ancient times and that each of them had advanced to such an extent so as to possess well established rules. In support of this we see, even at the present day, colossal buildings of rare architectural beauty, temples, beautiful pictures, life-like statues in granite, exquisitely moulded figures in different metals, ancient poems which delight the hearers to a remarkable degree and any number of Ragas to chant those poems in a melodious manner.

Just as a tailor is able to make a man's coat when the measurement of his neck alone is given, our ancestors were able to cut out the figure of a man from granite or mould his figure with only the dimensions of the little finger for a clue. They were able to make the figure of a woman, with the help of her hair, which went floating along in water, its length and thickness alone being known. In proportion to this advanced knowledge thay had some measurements in each science which exist even at the present day.

On the other hand, we find from experience that the measurements of Srutis which form the basis of all music (the best of fine arts) and the system of producing Ragas from Srutis, have gone out of use for many years. Fortunately, these Srutis, the Ragas based upon those Srutis, and the compositions of our ancestors have been preserved by traditional and oral transmission. We have to regret that the music of those who are ignorant of Srutis and the Ragas derived from them is as useless as the linguistic ability of a man who has learnt many languages just by hearing them talked, without being able to read or write any of them.

Many scholars have worked in this important field for years and have published their experience and the resutt of their researches in the form of books. Hoping that some of the distinguished Karnatic musicians would help in arriving at definite conclusions as regards Srutis, the Sangeetha Vidhya Mahajana Sangam was started by me in Tanjore on the 27th of May 1912. We have had six conferences till now and many different opinions have been given as regards Srutis. This led me to give my own views on the subject. I sincerely believe that my system of Srutis is flawless I also presume, like the great writers that have gone before me, that my system would clear the doubts of all Indians. I beg that this presumption of mine, will be pardoned by the scholars present in this assembly as well as by His Highness the Gaekwar, v versed in all arts and sciences.

"Karunamirtha Sagaram" is the name of my book treating on Srutis; 872 pages of this book have been already printed and only a few more pages remain. Of the 512 pages have been already translated into English and printed. Though my work is still incomplete, as I received orders that I should say something about Srutis before the "All-India music conference" and before H. H. the Gaekwar, I am compelled to reproduce a few points from my printed book.

Sarnga Dev has given his opinion about Srutis very clearly. We gather from ancient Tamil works that Ilankovadigal has also written very lucidly on the subject. think we shall do well to examine the systems of the above two writers.

I sincerely thank your Highness as well as the learned scholars who have **assembled here for the purpose of arriving at truth and establishing it at any cost.**

The system of Dwavimsati Srutis according to Sarnga Dev, the author of Sangeetha Ratnakaram, and the opinions of different writers who determine the Dwavimsati Srutis in an octave by taking Sa-Pa as 2/3.

President and Members of this Conference,

It seems that from the time of Pythagoras, the Greek philosopher, who visited India about 2500 years ago for purposes of obtaining information, the system of determining the Swarams of an octave by the principle of SA-Pa ⅔ and Sa-Ma ¾ began. We know that the Sthayi never comes to a perfect end while adopting either of the measurements. The fact that the series of Swarams obtained by the principle of ⅔ (Sa-Pa) extend a little beyond the octave, while the series obtained by Sa-Ma or ¾ fall a little short of the octave, was the cause of difference of opinion among the writers as regards Swarasthanams. Many writers in India have written treatises as regards the theories of Swarasthanams which they have arrived at after strenuous labour. The works of Bharata (V Century A. D.) who is looked upon as the pioneer of music and that of Sarnga Dev (author of Sangeeta Ratnakaram) are held in very high esteem at the present day as standard works on Indian Music. The above two writers speak of 22 Srutis in the octave. But they never give the measurements Sa-Pa ⅔ and Sa-Ma ¾. They derive 13 Srutis by the Sa-Pa series and 9 by the Sa-Ma series and claim the relationship of Vadi and Samvadi for these Swarams. Moreover, Sarnga Dev gives a few directions as to how these Srutis of an octave should be derived. Speaking about the progression of sound in the Sthayis, he says that the one of Mandara Sthayi becomes two in Madhya Sthayi and four in the Thara Sthayi thus gradually proceeding upwards in a particular ratio. As regards Srutis he says that the 22 Srutis of an octave are a gradually ascending series with a uniform ratio without admitting any other possible sound between. Then as regards change of Graham he says that when out of the four Srutis of Sa two are lessened, the Ga and Ni become Ri and Dha and when three Srutis are lessened, the Ri and Dha become Sa and Pa. Putting all the above three directions together we see plainly that he derives the 22 Srutis in the octave by Geometrical Progression. I have given the mathematical calculations for the 22 Srutis in the octave, their position in a wire 32 inches long, the number of vibrations and the cents calculations. This is the only and right method by which Srutis can be derived in accordance with the Slokas of Sarnga Dev. The change of Graham can be made possible only if this method is adopted. No matter where we commence the Swarasthanams, the change of Graham will be possible only if the pitch of sounds be uniform according to Sarnga Dev. This clearly implies that the Srutis should be of equal intervals. On the other hand many give measurements of Srutis with unequal intervals quite contrary to that of Sarnga Dev, and try to palm them off as those of Sarnga Dev. There is not the slightest resemblance between the theory of Sarnga Dev and those of the writers on Swarams and Srutis of the modern day.

According to Sarnga Dev, Pa or $\frac{3}{2}$ has 709 cents while according to others it has 702; the Ma of Sarnga Dev has 491 cents while that of others has 498. If there is such a difference as regards the two fundamental Swarams Ma and Pa in music, either of the two opinions must be wrong. But we know that the Swarams Ma and Pa are $\frac{4}{3}$ and $\frac{3}{2}$ approximately. If there is a slight mistake in an opinion that has been commonly aceepted, it is our duty to correct it and advance it instead of rejecting it altogether. If we notice the Swarams and Srutis of the Karnatic Ragas used in the beautiful Tamil country where music was fostered from ancient times, we may observe that the music was one which has had its excellent rules for thousands of years, that the Swarams Sa-Pa $\frac{3}{2}$ and Sa-Ma $\frac{4}{3}$ were known as Inai Swaram or Kalathira Swaram and Kilai Swaram or Putthra Swaram respectively and that the same relation of Swarams as Kalathira and Putthira are found in the fifth and the seventh Sthanams in Astrology. The doubt about the Dwavimsati Srutis found in the writings of Bharata, Sarnga Dev and other writers who make mention of the principle of $\frac{3}{2}$ and $\frac{4}{3}$ is completely dispelled by Silappadikaram, an ancient Tamil work written by Ilankovadigal (about 50. A. D.) which gives a few rules about Isai-Tamil. There we may see the 12 Swarams of Ayapalai derived by the Sa-Pa and the Sa-Ma systems, the 24 Alakus of Vattappalai where Ganam was made possible with two Alakus less, the different Yals of Vattapalai and the four Jathis derived from each of them and the measurements for the Srutis of Thirikonapalai and Chathurapalai. These will be clearly dealt with in the next essay.

The Sruti System of Sarnga Dev.

The Dwavimsati Srutis of Indian music according to Sangeetha Ratnakaram.

(Karunamirtha Sagaram in English p. 400 to 416)

Though many are of opinion that it is quite possible to determine the 22 Srutis in Indian music and to bring them to practical use, yet it seems to be a hopeless task owing to the conflicting opinions of the writers on the subject. Some of them have studied the Srutis of Hindustani music, and have given their opinion, while others pick out a line here and a line there from ancient authors and try to palm them off as their own However, we will do well to point out the contradiction in their theories first and then speak about the Srutis in use in South Indian music. For, it is manifest from the writings of the above authors, that they merely adopted the term Dwavimsati Srutis of Sarnga Dev and marked the Swarasthanams without trying to understand his real meaning in the determination of Srutis. Some gave Tables of Srutis which applied only to Hindustani music, which resembled more or less the modes of the Western musicians. Others copied the same Western modes, altering only a few Swarams here and there, and called them the Srutis of South Indian music. But it makes one smile to think, that all these conflicting theories are palmed off as the Dwavimsati Srutis of Sarnga Dev.

The above writers merely made the term Dwavimsati Srutis the burden of their song without understanding the real meaning and dignity of Sangeeta Ratnakaram, and distributed the Srutis in the octave in any way they liked. It is clear that they have not grasped even an iota of the meaning of Sarnga Dev. It is impossible to reconcile an ancient and imparacticable theory with a modern one. The ancient works should be examined in the light of modern criticism, and all that is imparacticable should be given up and all that is good should be accepted. An ancient work may continue to be good even at the modern day, but it may also be superseded by a modern work owing to exigencies of time. It is the duty of wise men to discriminate between the two and hold fast that which is good. It is not advisable either to give up an ancient work which is good on the plea of its being imparacticable now; on the other hand, an ancient work which conflicts with the modern practicability must certainly be discouraged. We shall understand presently that the system of Sarnga Dev is alien to South Indian music, just as it does not suit the music of the north. We have to examine here the system of Sarnga Dev because Sangeeta Ratnakaram is held in high esteem as the standard work on Indian music. So we shall determine the Srutis according to his system and compare them with those of other writers who also swear by him, and then draw our own conclusions and not blindly grope about in the dark like the above writers.

The very fact that the octaves as they proceed should have the vibration of their Srutis in Geometrical Progression shows, that the music of the ancient days was highly efficient. Just as the octaves proceed in the ratio of 1, 2, 4, 8 etc., so also the Swarams should do, he says. This should be carefully noted. Many have erred because they did not note this. We might clear all our doubts if we examine the 22 Srutis mentioned in his book, how they stand when the Gramams are changed and how far they agree. The different opinions given by the various writers on the 22 Srutis, namely, Mr. Sahasrabuddhi, Mr. Raja Surendra Mohan Tagore, Mr. Devål, Mr. Clements, Mr. Nagoji Row, Mr. Brave, Dr. Bhandarkar, Mr. Manicka Mudaliar who wrote Sangeeta Chandrika, Mr. Chinnasami Mudaliar, M. A., Mr. Subramania Sastrial, Mr. Panchapakesa Bhagavatar, Mr. Pratapa Ramasami Bhagavatar and others, made us conclude that the opinion of Sarnga Dev must be something different. The following Tables will show that the above writers who determined the Srutis, having his book as their authority, have gone clean out of his track as regards the Srutis. So we shall do well to find out the Srutis first according to his system, prove their correctness by seeing whether they stand the test of change of Gramam, and then compare them with the calculations of those who have interpreted him Then we shall come to the conclusion either that these are not Dwavimsati Srutis or that the author of Ratnakaram gives a completely different view.

The main idea of Sarnga Dev as regards Srutis given in his Chapter on Swarams is as follows:—

> "An idea in the mind generates Agni, which in its turn generates Vayu. This Vayu proceeds upwards from the Brahmakranthi or Mooladharam through the stomach, the heart, the trunk, the head and the mouth in the shape of Nadam. In these five places, Nadam obtains the five corresponding names of Ati Sookshmam, Sookshmam, Pushtam, Apushtam and Krithrimum. The Nadam increases in intensity in the ratio of 1, 2 and 4 being Mandaram in the heart, Madhymam in the trunk and Taram in the head. The sound which is thus produced has 22 varieties. The sound which could be distinctly heard is called Sruti. There are two breathing apparatuses going upwards from the heart which are called Idaikalai and Pinkalai. There are 22 (Nadis) arterial passages across these 22. When the air passes through them these passages dilate and the sound comes out. In the same manner there are 22 Sthanams in the trunk and the head. This may be proved with the help of two Veenas.
>
> Have two Veenas with 22 strings each. In the first Veena, tune one of the strings so as to produce the lowest possiple sound. Tune the second string so that it might sound the next possible note. No sound should be possible between the two. Arrange and tune all the wires on the same principle. Now the wires are arranged and tuned in a progressive series. Of these Sa has 4 Srutis. Fix the 4th of these Srutis as the Sa. Ri will have 3 Srutis, or in other words the 5th, the 6th and the 7th strings will be the varieties of Ri. The two Srutis of Ga will stand on the 8th and 9th wires. The four Srutis of Ma will be on the 10th, 11th, 12th and the 13th wires. The 14th, 15th, 16th and the 17th wires will sound the 4 Srutis of Pa, while the 3 Srutis of Dha will occur on the next three strings. The last two strings of the Veena will be responsible for the two Srutis of Ni. One of these Veenas is Dhruva Veena and the other Chala Veena. Alter the strings of the latter as directed below. If you arrange the seven Swarams commencing them from the 3rd Sruti of Sa instead of the 4th, you will have one Sruti less. If you commence the series from the second Sruti of Sa, Ga and Ni will obtain one of the Srutis of Ri and Dha.

If three Srutis are left out, Ri and Dha will have the 4 Srutis of Sa and Pa. But when you commence the series leaving all the 4 Srutis of Sa on the left Ri, Ga, and Ma of Dhruva Veena will correspond with the Sa Ma and Pa of Chala Veena. In other words, Sa commences on the 22nd, Ma on the 9th and Pa on the 13th. By this means, the calculations of Srutis may be obtained. From these Srutis proceed the seven fundamental Swarams Sa, Ri, Ga, Ma, Pa, Dha, and Ni.

Sa is of two varieties—Suddha Sa and Atchyuta Sa. When you reduce the 4 Srutis of Sa into 3, Ri obtains 4 Srutis. In the same way when Ma is reduced by one of its Srutis, it becomes Suddha Ma. When two of the Srutis of Sa are absorbed into Kakali Ni, it is called Achyuta Sa. This is a Vikriti Swaram.

In the same way when Ma gives two of its Srutis to Anthara Ga and has only two Srutis, it is called Achuta Ma. This is also a Vikriti Sruti. When Sa, with one Sruti less, commences the 22nd Sthanam, the 23rd Sthanam is Kaisika and the 24th Kakali. Both these Swarams are Vikriti. The Sa which comes in the 3rd place after Kakali is Suddha Sa. This is also a Vikriti Swaram. Ma is likewise Vikriti. In the same manner when Ma has only two Srutis, it is called Achyuta Ma, which is also Vikriti. When Ma gets merged into Suddha Ga, the first is Sadharana Ga and the second, Anthara Ga, which is also Vikriti. The Ma which has three Srutis less is Suddha Ma. When Pa has only three Srutis, it is called Trisruti Pa, which is also Vikriti. When Pa obtains the fourth Sruti of Sa, it is called Kaisika Pa in spite of its four Srutis. This is also a Vikriti Swaram. When Pa has four Srutis less, Dha gets one of the Srutis of Pa and thus has four Srutis, which is also a Vikriti. So also when Sa has one Sruti less, Ri gets 4 Srutis, which additional one is a Vikriti Swaram. To sum up, then, the 12 Vikriti Swarams are:—

Sa—Suddham and Achyutam—2
Ni—Kaisikam and Kakali—2
Dha—while obtainining one of the Srutis of Pa—1
Ri—when obtaining one of Sa—1
Pa—Tirusruti Pa and Kaisika Pa—2
Ma—Suddham and Achyutam—2
Ga—Kaisikam and Kakali—2

The Suddha Swarams are 7. The three Swarams are, Ri in Sa, Ma in Ga and Dha in Pa.

The method adopted by Sarnga Dev for determining Swarams could be clearly understood by those who know the working and harmony of nature. There could be nothing there which they cannot understand. This is the place where the high water mark of South Indian music is clearly seen. Just as it is clearly stated that the Sthayis should proceed at the ratio of 1, 2, 4 &c., so also the Swarams of a Sthayi, should proceed with a uniform interval. We shall see how Sarnga Dev proceeds. He says, first take a Veena with 22 strings. Tune the first string so that it may produce the lowest possible sound. The next string must be tuned to sound the next possible note. There must be no possible sound between the two strings. So when the 22 strings are tuned on the above principle, the Srutis ascend in a regular serial order till the octave is reached. This is a natural series, and this has been stated in the easiest language possible. In addition to this he gives the measurement of each Sruti also in the clearest language. But there is also something occult attached to it. He did not dilate upon it, because he knew that men of learning will easily read between the lines.

When a stone is thrown in the middle of placid water, waves are formed round the central point which gradually increase in diameter and decrease in intensity at a regular uniform interval. The vibrations of a Swaram are of the same nature. The Swarams in a wire proceed upwards at regular uniform intervals, whereas the Sthanams in the wire go on in an inverse ratio. This is what Sarnga Dev meant when he said that the Sthayis should proceed upward at the uniform ratio of 1, 2, 4, 8 &c., If the Swarams proceed at the ratio of 1 to 2 in the first octave, it is 2 to 4 in the second, and 4 to 8 in the third. But the length of wire for each octave is exactly the reverse. If the first octave finishes in the first half of the length of the string, the second octave finishes in the quarter of the length, the third in $\frac{1}{8}$ of the length and the fourth octave in $\frac{1}{16}$ of the length, and so on. The vibrations and length of wire vary in inverse ratio. Just as the first wave in the pond has a large intensity and small diameter, and just as the diameter increases, the intensity diminishes, so is the case with sound waves also. Again, when a ray of light from the eye proceeds in a triangular form and falls upon an object, at the apex of the triangle the sight is distinct while it gets obscure at the base. But at the apex the area seen is small, but at the base the area seen is extensive so as to include even two hills. So is the case with sound waves also. Scholars will acknowledge that this rule is true of all objects of nature. The growth of leaves, flowers, petals of flowers, and seeds of grass, herbs and plants, the inner growth of trees, the growth of animals, the growth of pearls, corals, and oysters, and the inner growth of the layers of the earth—all these show a regular uniformity in their upward and onward progress just like sound waves. In the same way, heaven and earth and all creation obey the law of regular growth, support each other in their harmonious working and thus declare the omnipotence of the Creator. We all believe in what the Holy Bible says, "In the beginning was the Word." The whole world was created by the Word and the self same Word was the life. The same Word was the cause of the variety of Nadam, which manifested itself as Sapta Swarams, as the different Srutis and later on as Geetams. If Nadam did not obey the law of uniformity, there could be no harmony of sweetness.

Sweetness is caused by uniformity. Whether they be colours, or sounds, or tastes, or qualities, or smells, or sensations of touch or knowledge, unless they be proportionately made up, they will be abhorred by every one. If in an article which is compounded of five different ingredients, there is one more or less, it will not taste well. This is our every day experience. The same with taste. So if sound, its harmony and the calculations of it in a wire vary, how could it be sweet? It will be just the reverse. The series of sounds which have no uniform ratio between them will only form an abhorrent discord. Will musicians of repute accept such strange sounds and measurements? Every one must agree that any system, which has no uniformity in length of wire and its corresponding sounds. must be wrong. The very fact that it is said that the octaves must proceed upwards in the ratio of one to two, and that the series must proceed gradually with a uniform interval between them without admitting other possible sounds between, shows that the ancients had clearly understood the uniformity of the law of nature. People are quite at liberty to form their own theories with their own measurements and put them into practical use also. But, what we object to is, that they should call it the system of Sarnga Dev.

In spite of the clear statement that the series must be uniformly progressive without admitting other Swarams between, one writer says that the octave should be divided into 22 equal parts.

Another locates MA in the exact middle of the whole string and distributes 9 Srutis equally in the half length, namely 3 RIS, 2 GAS and 4 MAS. The other half he eqally divides into 13 parts, 4 for PAS, 3 for DHAS, 2 for NIS and 4 for SAS.

Yet another mentions 4 RIS as well as 4 DHAS. This class of writers at least made equal divisions of the strings. But knowing that the length of wire will not exactly correspond with the sounds produced, they left off saying anything about the other half of the string.

Yet others, though they say the sounds must be of equal inlervals, they forget the fact altogether; give measurements which do not agree either in sounds or the length of the string, and try to multiply them with fractions for equalising them, which has landed them in difficulties. Those irregularities have been dealt with altogether. Their chief errors will also be pointed out hereafter from time to time.

How strange it is that the opinions of the ancient musicians of this Bharatakhandam noted for its excellence, and which was the birth place of so many eminent sages should be thus set aside and disregarded! How strange it is that their Sootrams should be changed and mutilated and mis-interpreted and added to, in this reckless manner!! The ancients, who were strong on account of the excellence of their penance and who were clever in Yogam, Gnanam, Vatham, Medicine, Astrology, Oviam, Geetam, use of weapons, Mantram, Vasyam and Occultism, have reserved the keynote of each science for the purpose of teaching it in person to those best fitted to receive it, and so have not stated them explicitly. This fact is mentioned in the books. Some have become perplexed owing to the voluminous pages of the books. Many have discredited them as pure lies. There were only very few, who understood those mystic keynotes by learning them in person from those eminent men who knew them. They have said in their works,

"They are so hard-hearted that they will not tell them to every one they see."

"They will not tell the truth to anyone. Those who tell others are ignorant and wicked."

II.

"Try to understand the mystery which is buried without your knowledge, and prosper."

"Those who were willing to help, wrote work, but hid the mystic truth from others."

"The science that is not learnt with the help of the Guru cannot be acquired even by the sweat of the body."

"It (the mystery) will seem to be plain to the eye of everyone, but, without the favour of the Guru, it can never be acquired."

The mystery of each science is taught at their last moments to a worthy disciple of theirs whom they could trust. In the Chakram with fortythree triangles which is established in all the temples by Sankarachariar, the Jagat Guru, all is plain with the exception of one little secret, which is the key of the whole Chakram, and which is not visible to the ordinary individual. Without knowing the secret key the chakram could never be understood. The key is so arranged that while you say thirteen it really means, fourteen, that by an easy sign or writing on the ground you must indicate one should be added. In the same way there are such hidden mysteries in other sciences which cannot be understood unless told by the Guru. The same applies to the science of music. This secret has been revealed from time to time only to a select few and put into practice either by the special favour of God or as a result of unremitting labour. Such secrets pertaining to the science of music and the system of their interpretation will be mentioned later on.

The Calculation of a Sthayi.

What we have to notice specially now is, to determine the measurements of Swarams from the fact that the Madhya Sthayi finishes in the first half of the string and the vibrations of the Swarams from the fact that the Sthayis proceed in Geometrical Progression. Let us assume for this purpose that the length of wire is 32 inches, and the vibrations of Sa 540. The reason for the above assumption will be mentioned under the heading "The Srutis of South Indian music." The measurements of all writers have been reduced to this uniform standard, so that they may be easily compared. Lovers of Indian music! We have determind to write at length and bring this affair to a satisfactory conclusion so that others may not laugh at us for quarrelling without understanding each other. But it is not an easy matter to reduce the various measurements to this particular standard. However, we have brought everything to a uniform standard and have given it in the form of Tables which might be easily understood by all.

We know very well that the ancients skilled for ages in the Science of Astronomy, have devised mnemonics (Dhruva Vakkiams) for remembering the minute calculations. The primary numbers are called Moola Dhruvams, and the resultant integers are called Varundhravams (products). Thus they have made this science easy as is seen from their writings here and there. From all this, it is clearly seen that our ancestors must have had an easy key for even the most difficult of calculations. As we have no such keys in vogue at the present day, we have made use of the Table of Logarithms of an eminent English Mathematician noted for his learning and researches.

TABLE 44.

Showing the 22 Srutis of Indian music according to Sarnga Dev, the author of Sangeeta Ratnakaram.

No. of the Swaram or the Sruti.	Name of the Swaram or Sruti.	Logarithm.	No. of the Logarithm.	No. of vibrations of Swarams if SA=540.	Decimal fractions showing the places of Swarams if the Adhara SA=1.	The Location of Swarams in a wire 32 inches long.	The interval between Srutis.	Cents.	Cents for the interval between Swarams.
1	2	3	4	5	6	7	8	9	10
0	S_1	0	1·000000	540	1·0000000	32·000000		0	
1	S_2	·01368318	1·032008	557·28432	0·9689844	31·007501	·9925	54·55	54·54½
2	S_3	·02736636	1·065041	575·12268	0·9389310	30·045792	·9617	109·09	54·54½
3	S_4	·04104955	1·099131	593·53128	0·9098096	29·113904	·9319	163·64	54·54½
4	R_1	·05473273	1·134313	612·52848	0·8815912	28·210918	·9030	218·18	54·54½
5	R_2	·06841591	1·17062	632·1348	0·8542482	27·335942	·8750	272·73	54·54½
6	R_3	·08209909	1·208086	652·3686	0·8277522	26·488102	·8478	327·27	54·54½
7	G_1	·09578227	1·246758	673·2493	0·8020800	25·666560	·8215	381·82	54·54½
8	G_2	·10946545	1·286665	694·8000	0·7772029	24·870493	·7916	436·36	54·54½
9	M_1	·12314864	1·327849	717·0379	0·7530978	24·099130	·7714	490·91	54·54½
10	M_2	·13683182	1·370351	739·989	0·7297400	23·351680	·7474	545·45	54·54½
11	M_3	·15051500	1·414214	763·67556	0·7071068	22·627418	·7243	600	54·54½
12	M_4	·16419818	1·45948	788·1192	0·6851755	21·925616	·7018	654·55	54·54½
13	P_1	·17788136	1·506196	813·34584	0·6639245	21·245584	·6800	709·09	54·54½
14	P_2	·19156455	1·554406	839·37924	0·6433325	20·586640	·6589	763·64	54·54½
15	P_3	·20524773	1·604160	866·2464	0·6233790	19·948128	·6385	818·18	54·54½
16	P_4	·21893091	1·655507	893·9732	0·6040447	19·329430	·6187	872·73	54·54½
17	D_1	·23261409	1·708457	922·5878	0·5853100	18·729920	·5995	927·27	54·54½
18	D_2	·24629727	1·763182	952·1183	0·5671563	18·149000	·5809	981·82	54·54½
19	D_3	·25998045	1·819619	982·5948	0·5495656	17·586099	·5629	1036·36	54·54½
20	N_1	·27366364	1·877862	1014·04548	0·5325206	17·040659	·5454	1090·91	54·54½
21	N_2	·28734682	1·937968	1046·50272	0·5160040	16·512128	·5285	1145·45	54·54½
22	S	·30103000	2·000000	1080·00000	0·5000000	16·000000	·5121	1200	54·54½

The calculations of the Dwavimsati Srutis.

We shall first see how the 22 Srutis are a gradually ascending series beginning from Adhara Sa and ending with Tara Sa which is its double. according to the theory of Sarnga Dev.

The Logarithm of 1 is 0 and that of 2 is ·3010300. Now let us see how the 22 Srutis proceed gradually from 0 to ·3010300 without admitting any interval between. We can obtain the Logarithms for the Sthanams from 1 to 22 if we divide the Logarithm of 2 by 22 and multiply the quotient by the numbers of the Srutisthanams one after another by 1, 2, 3, 4 &c. Now, if we divide the Logarithm of 2 or ·3010300 by 22 we get ·01368318 or the Logarithm of the first Sthanam. This is the Logarithm of the second of the four Srutis of Adhara Sa Multiplying this by 2 we get ·02736636. This is the Logarithm of the third of the Srutis of Adhara Sa. Again if we multiply the Logarithm of the first Sruti by 3 we obtain ·04104955, which is the Logarithm of the fourth Sa. Likewise we may arrive at the Logarithms of the 22 Sthanams. They stand in the ratio of $2^{\frac{1}{22}}$, $2^{\frac{2}{22}}$; $2^{\frac{3}{22}}$, and so on and nothing more. The Logarithms for the 22 Sthanams may be found in column 3 of Table 44. If we determine the numbers for the Logarithm between 1 and 22, we may notice how they gradually rise in an equal ratio between Adhara Sa=1 and Tara Sa=2. We have stated before, that the Logarithm of 1 is 0. Therefore for Logarithm 0 the number is 1. This is Adhara Sa. So the Logarithm of the Adhara Sa is 0. For Logarithm of the first Sruti or ·01368318 the number is 1·032008. The Logarithm of the second Sruti or ·02736636 obtains the number 1·065041. The same process will give the numbers for the series which may be found in column 4 of the Table. Here we may see clearly how the series proceed gradually with equal intervals. To test the correctness of these figures we have given their decimal fractions also correct to six: seven and even eight places. If we take the decimals only to two or three places they will be found still more easy to demonstrate. However, we shall do well to compare at least four places of decimals, so that the calculations may not in course of time get out of reckoning gradually as was the case with the Srutis. Just as we found that the Logarithm of 2 was ·3010300. so we shall see clearly that the Logarithm ·3010300 gets 2 as its number.

The calculation of vibrations for the 22 Srutis.

We know that the theory of Sarnga Dev is—that if the first Sthayi is 1, its Octave must be 2. If Adhara Sa is 1, its Octave must be 2. We noticed beforehand the 22 intervals between 1 and 2. In the same way we must observe how the number of vibrations beginning from Adhara Sa=540, proceed upwards in equal ratio for the 22 Sthanams. Adhara Sa has 540 vibrations per second. This has been noted in column 5 of the Table as 1 × 540=540 or the first number. In the same way, if we multiply the number 1·032008 (equal to the Logarithm of the first Sruti found in col. 4) by 540 we get 557·28432. Likewise, the number 1·065041 equal to the Logarithm of the second Sruti when multiplied by 540 gives 575·12268. So also, the numbers of the Logarithms for the 22 Srutis when multiplied by 540 respectively, will give us the number of vibrations found in column 5 of the Table. The 22nd Srutisthanam will end with 2 × 540 or 1080 vibrations.

Till now we have noticed at what lengths the 22 Srutis occur in the wire and the number of vibrations of each Sruti. It is better to keep the calculations of the Srutisthanams in decimals and ensure their correctness up to two, three or four places. But if we take the calculations by vulgar fractions, the process of multiplying will cause much difference.

The calculation showing where the 22 Srutis occur in a wire 32 inches long.

We must next proceed to locate the 22 Srutisthanams in a wire 32 inches long. The Adhara Sa occurs at the commencement and the Tara Sa in the exact middle of the whole length of a wire. Therefore we must find out how the 22 Srutis gradually decrease in the length of the wire within half the total length. The Adhara Sa has 540 vibrations. . sounds at the Meru which is 1. We have shown in the fifth column of Table 44, how the first Sruti has 557·28432 vibrations. If we divide 540 by 557·28432 we get ·9689844. In the same manner if 540 be divided by 575·12268, which is the number of vibrations of the second Sruti, we get ·9389310. In the same manner, if we proceed to divide 540 by the number of vibrations of the third, the fourth and the fifth etc., Srutis, we will obtain the lengths of the wire given in column 6.

We get ½ or ·5 for the 1080 vibrations opposite the 22nd Sruti. This shows how the 22 Srutis gradually decrease in the length of the wire from Adhara Sa which is 1 to Tara Sa which is ½ without admitting any other possible Sruti in the interval.

We shall next proceed to note where the Srutis occur in the wire which is 32 inches long. We all know that the Adhara Sa sounds in the Meru, and the Tara Sa sounds at the 16th inch or one half. These 22 Srutis must occur within these 16 inches, and they must rise step by step from the Adhara Sa Not only they should rise step by step but must not admit of any other Sruti in the interval and the Sthayi must come to an end exactly at half the length of the wire. In the sixth column of the above Table, may be found the different lengths of the wire for the 22 Srutis in half the total length. We shall now proceed to locate them.

If we take the Meru to be 1, the 32 inches end there. So it becomes 1 × 32 or 32. This is the first measurement in column 7 of the Table. The first Sruti or the second of the four Srutis of Sa, is ·9689844 of the total length (see the second number in col. 6). If we multiply this by 32 we get 31·007501 which is the second measurement in col. 7. Likewise, if the 2nd, 3rd, 4th, 5th and the 6th Srutisthanams in col. 6 be multiplied by 32 we shall be able to get the particular length in which each Swaram should sound. ·5 of the 22nd Sthanam when multiplied by 32 gives us 16. All these measurements are found in col. 7. We may notice a particular uniformity and harmony between the Swarams if we look into these calculations.

The harmony between the Srutis.

Just as the numbers in col. 1 are of a uniform order, just as they increase by a common uniform ratio, in the same way the figures in the other columns also have a certain uniformity in them. Any Sthanam may be taken as the standard and the measurements proceeded with, there will be no difference in the ratio. 1 will be to 4 as 4 is to 7; 7 will be to 10 as 4 is to 7; 5 will be to 9 as 1 is to 5 or 9 is to 13 or 13 is to 17 or 17 to 21. 9 will be to 17 and 13 to 21 just as 1 is to 9. 13 will be to the 3rd number of Tara Sthayi or 25 just as 1 is to 13 or 9 to 21. All measurements in the other columns will have the same uniformity.

We might also go a little deeper and see a little more clearly how these Sruti Sthanams stand in equal proportion to one another without any difference. The number obtained for the Logarithm of the first Sruti in col. 4 when multiplied by itself gives us the figure for the second Srutisthanam. In the same way, if the second be multiplied by the number of the first we obtain that of the third.
For example,

1·032008 × 1·032008 = 1·065041. If this be again multiplied by 1·032008 it gives us 1.099131, the figure for the third Sruti. If this again be multiplied by 1·032008 we get 1·134313, the figure for the fourth Sruti. In the same manner every figure when multiplied by that of the first Srutisthanam gives that of its next Srutisthanam. Again, the figure for the first Sruti in col. 6 namely ·9689844 when multiplied by itself gives the figure for the Second Sruti and which multiplied by that of the first Sruti gives the figure for the third, Etc.
For example,

·9689844 × ·9689844 = ·9389310; and ·9389310 × ·9689844 = ·9098095. In the same manner the figure for each Sruti when multiplied with that of the first, will give us the figure for the next. Likewise, if the figure for the fourth Sruti found in cols. 4 and 6 be multiplied by itself we get the figure for the 8th Sthanam which is its *vargam*, and if the same figure be multiplied by itself thrice, we get the figure for the 12th Sthanam which is its *ghanam*, and the same when multiplied four times by itself gives the figure for the 16th Sthanam which is its *varga vargam*. In the same manner, any figure taken, when dealt with according to the above rule, will give us proportinate results.

We might also notice another uniformity. The figure for the first Sruti in col. 4 if multiplied by the figure for the same in col. 6 will give us 1. (1·032008 × ·9689844 = 1). The same holds good if the figures for the second Sruti be so multiplied (1·06504 × ·9389310 = 1). The figures for the 22nd Sruti when multiplied together give us the same result. (2 × ·5 = 1). Men of knowledge will clearly understand these truths.

Again, if we look at the cents calculation in cols. 9 and 10. we may find that they proceed by a common ratio, 54·54 or nearly 54½.

Besides this, the decimal fractions in col. 6 when multiplied in a particular order will always give us the product ½. For example, multiply the figures for Adhara and Tara Sa, or those for the first and the 21st Srutis, or those for the second and the 20th Srutis, or those for the 3rd and the 19th; the result will always be ½. In the same ay, if the figures for Adhara and Tara Sa in col. 4 and for the 1st and 21st, 2nd d the 20th, 3rd and the 19th be multiplied together the product will always be 2. e middle or the 11th Sruti must be muliplied by itself to obtain the same result·

These calculations might be multiplied and explained in many different ays. But what we have said is quite enough to determine the exact position of the utisthanams.

This is the method given by Sarnga Dev for determining Srutis. We firmly sert that no other method could give the proper measurements, if, according to Sarnga ev. the two Sthayis must be in the proportion of 1 to 2, and the 22 wires should pro- ice a gradually ascending series of 22 Srutis in the octave without admitting any other und in the middle. Men of understanding must certainly admit this. Unless the ngs of a ladder are equidistant, it will be impossible to go up and down the ladder. his is our everyday experience. If there is no such uniformity in the ladder of sounds will be a stumbling block. It is strange that they have not understood this. They e not to be blamed. They stumbled because they tried to multiply the fractions head wnwards. The Srutis also shared the same fate and became a discordant series. ch one believed that he was following the method of Sarnga Dev and it would be explicable to others, with the result they all completely strayed away from the method Sarnga Dev. These writers who said they had all followed the one method, differed ry much from each other. And they tried to perpetuate their different methods and ed to reconcile them with those of modern music by obtaining supporters for their spective theories; yea, they went a step further and invented instruments to support e fraud. They only excite our pity. We fear that the South Indian music will share e fate of the ship that is caught in the middle of the ocean during a terrific storm d darkness caused by the eclipse of the Sun in the sign of Thulam (துலாம்.)

Applying the principle of changing the Gramam to their new Swarams which ay away altogether from the principle of Sarnga Dev and finding they are not at all agreement with his calculation, some of them say that a few Srutis are newly form- in the process. One of them says that three new Srutis generate from the Shadja amam, Madhyma Gramam and Gandhara Gramams respectively, while another fore- ing danger such a process and knowing the Srutis will not agree, quietly omits them. t another hoping that if there were 53 Srutis in the octave the trouble might be got l of, establishes 53 Sthanams by the Sa-Pa series and says he has picked out 22 out them. Are not the theories which try to establish 23, 24, 25 and even 53 Srutis in octave quite contrary to Sarnga Dev and his 22 Srutis? We should particularly e that the 22 Srutis, when subject to change of Gramam, should not vary in their pective calculations or sounds and that they should satisfy the principle of harmony Vadi and Samvadi. If the 22 Srutis are of a uniform order in calculations as well as nds they would certainly stand the test of Vadi and Samvadi in any Gramam, ginning from any Srutis whatever. If two ladders whose rungs are equidistant and of same size were tied together exactly one over the other or tied in such a way that ung of one is on any of the rungs of the other either in the three quarters or half or quarter parts, they will certainly serve the purpose of going up and down convenientl But if the two have different kinds of rungs which are not equidistant, the use of the separately will certainly be difficult. But if we attempt to tie ¾ of one with the ¼ the other or ½ of one with the ½ of the other the results will be the production of a nu ber of rungs at irregular intervals. The difficulties and objections raised against t system of 22 Srutis are to be traced to their irregular measurements. It will be mo to the point, if the advocates of the system will reduce to notation the Geetams whi they sing and bring it into practical use On the other hand, they adopt a syste which is unnecessary and impracticable, and of which they are ignorant, and carry on war of words which will certainly not be accepted by men with knowledge. Agai the more they attempt at change of Grahaswaram, the more the absurdities accumula and land them in difficulties just like the accumulations of dust of the iron pestle of t Yadavakulam. Even these absurdities will have to be noted here. This will he people to understand whether the Srutis according to Sarnga Dev or the Srutis a cording to these authors are correct.

The principle of changing Graham according to Sarnga Dev.

We noticed till now, the system of Sarnga Dev where the 22 Srutis a derived in the octave with the aid of the first Veena with 22 strings where they a arranged in a gradually ascending series without admitting any other sound in th middle. Let us now notice his principle of changing Graham. He says that the seve Swarams occurring in the 4th, 7th, 9th, 13th, 17th, 20th and the 22nd Sthanams of th first Veena should be made to sound in the 3rd, 6th, 8th, 12th, 16th, 19th and the 21s string of the second Veena. This is exactly the same as beginning the ourth Sruti o Sa from the third Sruti of Sa and proceeding upwards so that the seven origina Swarams occur at the Sthanam one Sruti less. In the same manner, if the fourth S starts from the second Sa then each Sruti will occur in places 2 Srutis less. So Ga an Ni will occur on Ri and Dha. Thirdly, if the fourth Sa commences on the first Sa, R and Dha lose three places and occur on the 2nd, 3rd and the 4th Srutis of Sa and P Fourthly, when the fourth Sa commences on the 22nd Sthanam, Sa occurs on Ni, M on Ga, and Pa on Ma.

Beloved Readers! we understand from the work of Sarnga Dev that th names given by our ancestors to the Srutis were causing confusion even during his tim After him many writers have used many Srutis and Sruti names which are entirely co flicting with one another. To make matters worse, some modern writers have invented 53 Srutis and such fancy names as Vadiga and Chodika. So we have only nu bered the Srutisthanams so that you may not get confused with the different name and that one right conclusion might be arrived at as regards Srutis. We do not mak a display by giving a number of names of which we are not sure. We give only a many names as are necessary for a clear elucidation.

What we have to clearly note is the fact that just as the numbers 1, 2, 3, have a certain uniform ratio between them, just like the regular rungs of a ladder, s these Sthanams are also in regular uniformity with the same ratio in whatever direction they may be taken. If they do not have such a ratio, it is a matter well known t men of understanding that they will never agree with the first Swaram, when shifted here and there. If the 4 Sas, 3 Ris, and 2 Srutis of Ga were not of equal intervals how could the third Sruti of Ri agree with or coincide with the third Sruti of Sa, and the first Ga with the fourth Sa, when Sa commences on the 22nd Srutisthanam? Sarnga Dev made mention of a superior method where the Swarams also agree in the same manner. It is clear that he never advocated Srutis with unequal intervals.

Those who have doubts might easily clear them if they look at the Table in the next page.

He says that when we take a Sruti less in each case beginning from Sa 4 we get the Moorchanas of the Sapta Swarams. This he calls Shadja Gramam. What we have to note here is, that if Sa should commence from the 22nd Sruti of Ni it is absolutely necessary that there should be a Sthayi below. For the first Sruti should be the lowest possible one, and so any Sthanam below the first Sa can not possibly exist, for it cannot sound. So we should understand that the change of Graham is possible only from the Madhya Sthayi. We clearly see that for purposes of singing Graha Swaram and fixing the measurements there should be a Sthayi before Madhya Sthayi and one after.

Shadja Gramam.

Now we commence the Shadja Gramam. This has 22 Srutis with 4 Sas, 3 Ris, 2 Gas, 4 Mas, 4 Pas, 3 Dhas, and 2 Nis. Wherever we might commence the 1 Sruti, the Sapta Swarams should be similar in the measurement of the Sruti.

Madhyma Gramam.

In the same manner, this Gramam has 22 Srutis with 4 Sas, 3 Ris, 2 Gas, 4 Mas, 3 Pas, 4 Das and 2 Nis, while the Sapta Swarams should be used in the order of their Srutis in the various Ganams. We also note that Pa has one Sruti less or in other words, the third Sruti of Pa is used as its Pa and the fourth Pa goes along with Dha. While all the other Srutis sound in their own Sthanam, Pa alone sounds in its 3rd Sruti instead of the fourth. All the other Swarams remain Suddha Swarams.

Gandhara Gramam.

Next comes Gandhara Gramam the one that became celestial. He says that this Gramam should also have 22 Srutis with 4 Sas (1, 2, 3, &4), 2 Ris (5 and 6), 4 Gas (7, 8, 9 and 10), 3 Mas (11, 12 and 13), 3 Pas (14, 15 and 16), 3 Dhas (17, 18 and 19) and 3 Nis (20, 21 and 22). When they change the Graham they must occur with the same regular intervals. Here, all the other Swaram. with the exception of Sa, Ma and Ni lose the character of Suddha Swarams. For, the Ri instead of being the 7th Sruti becomes the 6th, the Ga becomes the 10th instead of the 9th Sruti. Pa becomes the 16th instead of the 17th Sruti, and Dha becomes the 19th Sruti instead of the 20th. Here Ri, Pa and Dha have each one Sthanam less, while Ga has one Sthanam more. So four Swarams get shifted from their usual Sthanam thus making Ganam difficult and involved. Perhaps on account of this difficulty all the great Vidwans had it banished to the celestial regions. We do not know what other things will share the same fate. We pray that God may save at least the remnants of South Indian music from sharing the same fate.

III.

As Sarnga Dev mentions that it was so banished even before his time, it is clear hat it went out of use ages ago. We are afraid that the same might be the fate of the hadjama and Madhyma Gramams belonging to this Ga.

In the Table, the opinion of Sarnga Dev who said that they should have the ame harmony while they changed the Graham. is indicated by numbers. For, the easurements given by Sarnga Dev for the 22 Srutis have the uniform intervals as in he numbers 1, 2, 3, 4 &c., and those measurements and sounds exactly correspond ith these. I have clearly proved there that they would not admit of any other easurement. I need not therefore repeat it here. The measurements found in the able, when compared with the numbers found in the Table of Gramams, will be ound to be exactly the same. They do not differ even in the slightest degree and they o not admit of any unequal intervals in the middle. While matters stand thus, one uthor boasts that he has discovered 2 more Srutis over 22, (22+2=24), another 3 more rutis (22+3=25) while yet another claims to have discovered 31 more (or 31+22=53). en of understanding will never accept these.

The application of Sa-Pa and Sa-Ma measurements to the theory of the 22 Srutis of Sarnga Dev.

We know that Sarnga Dev has freely used the Sa-Pa and Sa-Ma systems hich stand in the relation of Vadi and Samvadi. He says that where 8 Srutis occur etween two Swarams they stand in the relation of Sa-Ma. and where 12 Swarams ccur between two they stand in the relation of Sa-Pa. In other words, the 9 Srutis mitting the 1 will form Sa-Ma series, and the 13 Srutis omitting the 1, the Sa-Pa eries. All Swarams must conform to this system. This implies that if the Srutis ere of unequal intervals and measurements they will never agree.

It is to be noted that every one, who advocates any system of Srutis says hat he has proceeded by the Sa-Pa and Sa-Ma series. But their Swarasthanams are ot of a uniform interval. Though this is contrary to the system of Sarnga Dev they ill swear it is his. We have proved clearly by the Tables 15 and 16 on pages (306-307) hat the 22 Srutis obtain perfection in Tara Sa, the Sa-Pa series in the 13th Sthayi and he Sa-Ma series in the 9th. The same is repeated in the 9th column of Table 44 hich gives the system of Srutis of Sarnga Dev on page 406. When we proceed by ines we get the Sa-Ma series. If we multiply the cents against number 9 by 2 (*i.e.,*) f 490·91 be multiplied by two, we get the cents for the 18th place which is the next ne, and then the cents for the fifth Sthanam. So when the cents of the Srutisthanams re multiplied by the numbers 4, 5 and 6 in order, we get those for the 22 Srutis.

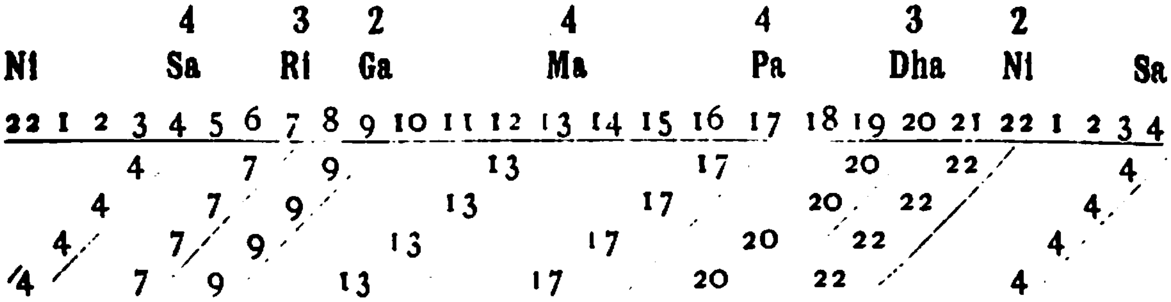
In the same manner, if the cents against the 13th Sruti 709·09 be multiplied by 2, 3, 4 and 5 we get the cents for the 22 Srutis of the octave. These intervals are ompletely perfect without even the slightest difference of a fraction. In this Table if Ma and Pa are reckoned from the fourth Sa, they will appear as the 12th and the 16th thanams respectively.

TABLE: 45.

The following Tables show clearly some of the remarks made about changing Grahams.

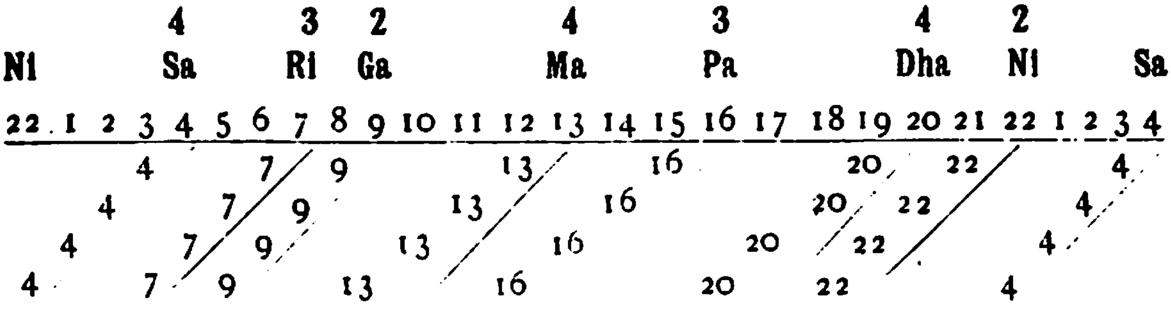
Shadja Gramam.

According to Sangeetha Ratnakaram.



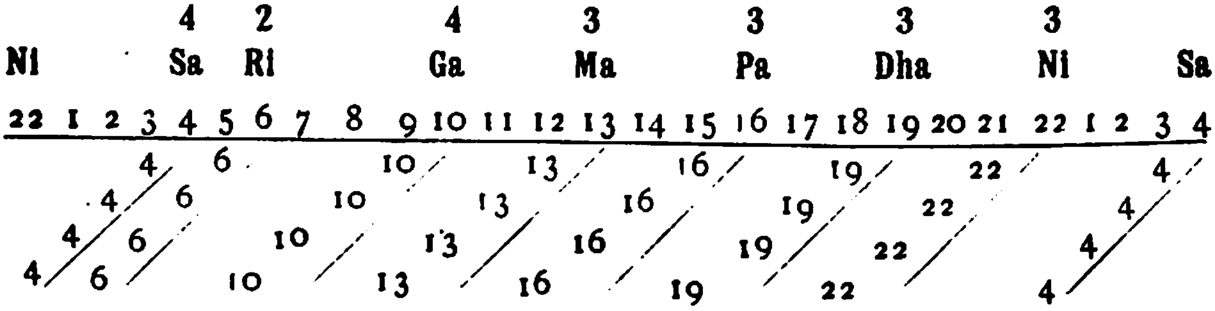
Madhyma Gramam.

According to Sangeetha Ratnakaram.



Gandhara Gramam.

According to Sangeetha Ratnakaram.



We shall presently see that if we do not admit of more than 22 Srutis in the octave according to Sarnga Dev and others, there will be a slight trouble when the change of Graham is made. In order to understand this clearly, let us compare the conflicting opinions of all advocates of the Dwavimsati Srutis.

A comparison of the different opinions of writers as regards the Srutis in use in Indian Music.

We see clearly that among the writers about Sruti, Sarnga Dev is the primary author and that he has followed the method of Bharata who lived long before him. Writers in India and in the Western countries profess to follow the system of Sarnga Dev but in reality they make us of the measurements $\frac{2}{3}$ and $\frac{3}{4}$. But this is not at all the system of Sarnga Dev. They are ready to raise objections when we say that their method is contrary to that of Sarnga Dev. So it is absolutely necessary we should compare his with those of others in measurement, fractions and cents.

TABLE 46.

Here, in this Table, I have marked the measurements of Srutis of different writers in a Veena String which is exactly 16 inches long, which is the first half of a Veena wire 32 inches in length. Their measurements are accurately marked in the Madhya Sthayi 16 inches long. Those who want to test the accuracy of their measurements by sounding them in the Veena might easily mark their Swarasthanams by fixing a long strip of paper 16 inches long against the column opposite their names. They may then fix the frets in their Veenas from the Meru up to 16 inches and verify the Swarasthanams on the Veenas. The bridge of the frets should not be broad but very thin so that they may indicate exact measurements. They must be so made as to be fixed and removed with the gretest ease. The Merusthanam should not be high. for then the strings will have to be held tight which might dislocate the Swsrasthanams. The difference in frets between the Meru and the other Swarasthanams should be the thickness of a piece of paper and no more. But it must be understood that this is not for the purpose of producing music on the Veena but only for testing the Swarasthanams.

TABLE 47.

This Table marks the Swarasthanam in a wire 32 inches long. This is for the purpose of testing the accuracy of the measurements given before.

TABLE 48.

This Table shows the fractions corresponding to the measurements of Swarasthanams in the wire.

TABLE 49.

This Table gives the cents calculations of the different Sthanams bringing out the difference in the fractions. This will be useful for comparing the different views.

We shall only notice one or two important points here. The measurements Sarnga Dev found in the first column closely follow his book. Those measurements l their uniformity should be clearly appreciated. The intervals, beginning from lhara Sa proceed upwards on a uniform ratio. In the same manner, the sound also reases gradually and finishes with 22 Srutis. We see that his superior system ows that of the others completely into the shade. Those who professed to follow regular method followed really the method $\frac{4}{3}$ and $\frac{3}{2}$. So the systems of other iters never tally with his. There is a difference of 7 cents between the Ma of Sarnga v (491 cents) and that of others (498) necessarily. There is also the difference of 7 its between the Pa of Sarnga Dev (709 cents) and that of others (702 cents). If the ndard Swarams Ma and Pa are thus different, what can we expect about others? asurements by two roads which are different will cause difference and trouble. e Table clearly shows this. Again, to bring out the discrepancy in measurements ll more glaringly, if a red line be drawn from Ri, in column 1 of Table 46, to all the Sthanams of the different writers, the line would never be a straight one! The ne will be found as regards Ga, Dha and Ni and other Swarams. They are not of iform intervals, nor do they follow Sarnga Dev, nor will they in any way suit matic music.

Some of the Tables of other writers and their opinions have not been added re as they reached us after this Table was prepared.

Two iinportant points which might help us arriving at the Srutis of Karnatic Music.

(Karunamirtha Sagaram in Tamil Page 512 and 513.)

Noble readers! Many eminent musicians have written about, and given their ticism on, Srutis that have been in use for the last 2400 years from the age of thagoras. We have seen that even today opinions vary as regards this subject. e have placed before you a few of those theories and pointed out how they contradict e another and how they are different from the systems of Sarnga Dev, Pythagoras d Ahobilar. Table 50 gives one the full idea of the subject.

From, all this it appears that if a new system, based upon all that has gone fore, could be evolved which has equal and uniform measurements, then that system ll certainly help us in determining the Srutis in use in South Indian music. While ing to unify the many systems that were different and arrive at the truth, I came oss a few ideas which are contained in an ancient Tamil literary work. This rk is considered one of the best and most ancient of Tamil works on music and one it could throw considerable light upon the controversy as regards Srutis. Moreover has the sanction of Shastras and gives a system of Srutis which might help in recit- the Sama Vedam. With the grace of learned sages I came across these ideas which ive below.

1. I hold that the system of Srutis of Sarnga Dev is the right one fo determinig the Srutis in use in Indian Music, and that no one could improve on thi system.

.In other words the series should proceed upwards from Athara Sa graduall with equal intervals admitting of no other Swarams in the middle.

2. Secondly, because Western Musicians as well as writers on Indian Musi unanimously declare that Sa-Pa is $\frac{2}{3}$ and Sa-Ma is $\frac{3}{4}$, these two series must be approximately taken to be $\frac{2}{3}$ and $\frac{3}{4}$ respectively.

According to modern writers while proceeding by $\frac{2}{3}$ or Sa-Pa system, we finish the series a little over the octave, and while proceeding by $\frac{3}{4}$ or Sa-Ma, we finish a little below the octave. This must never be. The measurements must be so accurate that the series must end exactly with the octave neither more nor less. Then we shall arrive at the Srutis in use in South Indian music, and all doubts about Srutis will entirely vanish.

If we have the above facts in mind, we shall be able to find out how man Srutis there are in the Sthayi with their respective measurements.

Unless we adopt the system of Sarnga Dev, the Srutis cannot be changed for the purpose of Grahaswaram nor will they suit Karnatic music.

If we do not proceed by the approximate measurements of Sa-Pa and Sa-Ma the Srutis will not suit Karnatic music. Therefore we should adopt the system of Sarnga Dev along with the mysterious key for tuning instruments given by him, and the system of $\frac{2}{3}$ and $\frac{3}{4}$. By the latter we do not mean the one recommended for those who have an ear for music, but the minute and correct Sa-Pa and Sa-Ma series.

Before we arrive at the right method of determining Srutis by the above two methods, we shall do well to see what works on Isai Tamil say, which were in use among the Tamilians, the most ancient of the inhabitants of India and the most renowned in South Indian Music.